FETC Coal Briefing
June 23, 1999

Overview:

Introductory Comments

Thank you for the invitation to speak here today. We at EIA appreciate the opportunity to learn more about the activities of our fellow agencies and our customers and to see how our information and forecasting products and services can contribute to their planning.

I will be discussing , initially, EIA's Annual Energy Outlook, with particular emphasis on coal and the market trends that will affect the time period through 2020. Then, I will cover a report that examines the potential impacts of the Kyoto Protocol.

The goal is to provide a mid-term framework for examining the some of the issues confronting the coal industry that will be discussed during this symposium.

Quick Overview of EIA and the AEO

EIA is the independent data collection and analysis arm of the DOE--it currently has approximately 370 FTE

The projections in the Outlook are based on the National Energy Modeling System--NEMS, a large-scale integrated energy model that EIA developed in the 1992-1993 period. Each year the model is updated with the latest data and modified as necessary to examine emerging issues.

NEMS provides detailed projections of energy supply, demand, and prices of all major energy sources through 2020. Its integrated structure permits the development of baseline and scenario forecasts that are can be used to examine the impacts of government policy on a wide-range of issues.

- The AEO99 reference case is based on data as of July 31, 1998 and assumes, for baseline purposes, that Federal, State, and local laws and regulations that were in effect at that time will remain unchanged through 2020.

It does not attempt to anticipate the nature or approval of future policy or legislative initiatives. As such, the Kyoto Protocol targets have not been included in the reference case forecasts. However, in the second section of this presentation, I will provide some model results regarding the range of possible impacts.

AEO & Short-Term Issues

- The AEO focuses on the mid-term--through 2020. As such, events of a more short-term nature such as weather, natural disasters, strikes, and facility outages are not factored into our trend projections. EIA short-term forecasts would change, but such events do not influence our view of the mid-term.

Oil Prices-Three Cases

World oil prices are projected to rise gradually from current levels $22.73 per barrel in constant 1997 dollars. Non-OPEC production gains and improved exploration and drilling technology are keeping costs in check despite rising global demand.

Oil prices have been particularly volatile over the last 2 years -- the low prices in 1998 were the result of abundant supply and weak worldwide demand.

If we convert the reference case projection to current or nominal dollars (See Inset Graph)--the price per barrel rises to $43.30 in 2020.

The AEO includes high and low oil price cases that reflect uncertainties regarding future levels of OPEC production. Prices range from $14.57 to $29.35 in 2020.

Natural Gas Prices

Prices at the wellhead grow at a rate of 0.8 percent annually.

The wellhead price in 2020 is $2.68 per MCF in 1997 dollars.

The moderate price growth coupled with lower capital costs, strong gains in generating efficiency, and certain environmental advantages have made natural gas a formidable competitor to coal for use in electric generation. In fact, natural gas consumption for electricity generation grows at a rate of 4.5 percent annually.

Before discussing our coal forecast, I would like to review the major trends and uncertainties in electricity markets ---the primary customer for coal.

Electricity Generation by Fuel (Figure 74)

- Coal-fired power plants are expected to remain the dominant source of electricity through 2020-- but to decrease in overall share of total generation from 53 percent to 49 percent in 2020.

- In percentage terms, natural gas generation increases the most, from 14 percent of the total to 33 percent in 2020, overtaking nuclear generation by 2003..

- Nuclear generation is projected to increase until 2000 and then decline as older units are retired.

- Electricity sales grow at 1.4 percent annually, compared to a 2.1 percent growth rate for the gross domestic product.

Electricity Generation and Cogeneration Capacity Additions (Figure 69)

- Over 1200 new plants, with an average capacity of 300 megawatts, are projected to be built by 2020, to meet demand growth and to offset retirements of old units.

- 88 percent of the new capacity is projected to be combined-cycle or combustion turbine technology fueled by natural gas or both oil and gas.

Electricity Generation Costs (Figure 72)

- Technology choice decisions for new generating capacity are made to minimize levelized costs while meeting local and Federal emissions constraints.

- In head to head competition for new capacity, highly-efficient advanced combined-cycle plants have lower levelized generation costs than new, conventional coal plants, despite a higher fuel cost component..

- The capital and O&M cost component for combined-cycle plants is one-third that for coal-fired plants.

- In 2020, new combined-cycle plants have levelized costs of generation that are 6 mills (6-tenths of a cent) lower than new coal-fired plants.

New Legislation Reduces NOx Emissions from Powerplants

- AEO99 includes the impacts of legislation for the control of NOx by electric generators, including the second phase of the Clean Air Act Amendments of 1990 and the Ozone Transport Rule, scheduled for the 2003 summer season--(May 1 through September 30).

SIP Call NOx Control Costs

- The compliance technologies available include combustion controls (including low-NOx burners), selective noncatalytic reduction, and selective catalytic reduction. Co-firing a coal plant with natural gas is also an option.

- The capital investment for these control technologies is expected to total about $8 billion.

- The total annualized cost for the technologies, including operating costs, is $2 billion.

SIP Call NOx Control Costs Relative to Sales Revenue

- The total annualized costs for NOx controls (bottom line of the graph)-are relatively small compared to annual revenue from electricity sales (which exceed $200 billion) -- less than 1 percent.

Electricity Price Projections: AEO99 - Fig 1A

- Real electricity prices (all sectors average) are projected to decline 0.9 percent a year between 1997 and 2020, from 6.9 cents per kilowatthour to 5.6 cents a kilowatthour.

- The projections reflect the ongoing restructuring of the electricity industry to a competitive wholesale market. The following regions are assumed to have competitive retail pricing: the Mid-Atlantic Council (Pennsylvania, Delaware, New Jersey, and Maryland), the Mid-America Interconnected Network, California, New York, and New England.

- As of April 1999, 21 states had enacted legislation or promulgated regulations establishing retail competition programs. Most of the remaining states have the matter under active consideration.

Coal Consumption for Electricity and Other Uses: AEO99 - Fig 114

- Domestic coal demand rises by 245 million tons in the forecast, from 1030 million tons in 1997 to 1275 million tons in 2020.

- Throughout the forecast, electricity generation accounts for approximately 90 percent of domestic coal demand.

- The growth in coal consumption for electricity generation is the result of higher utilization of existing equipment (rising from 67 to 79 percent) and additions of new capacity in later years -- 32 gigawatts of new capacity .

Non-Electricity Coal Consumption: AEO99 - Fig 115

- An increase of 12 million tons in industrial steam coal consumption is offset by a 9 million ton reduction in coking coal consumption.

- Increases in steam coal consumption are primarily in the chemical and food-processing industry, as well as cogeneration.

- Coking coal consumption declines as a result increased use of electric arc furnaces, process efficiencies, and increased imports of semi-finished steels.

U.S. Coal Exports: AEO99 - Fig 116

- U.S. coal exports rise slowly in the forecast from 84 million tons in 1997 to 93 million in 2020, as a result of higher demand for steam coal imports in Europe and Asia. U.S. exports of metallurgical coal in 2020 are 3 million tons lower than the 1997 level.

- The recent worldwide financial crisis has introduced some changes in international markets, affecting trade patterns and prices. In international markets, coal prices are negotiated in U.S. dollars. Currency devaluations against the U.S. dollar and contracting markets have placed strong downward pressures on U.S. sales. Australia and South Africa have lowered prices substantially in key markets.

Coal Production by Region: AEO99 - Fig 107

- Total coal production grows at a rate of 0.9 percent, reaching 1358 MMT in 2020.

- The western share of coal production is growing steadily and will soon exceed that mined east of the Mississippi. River. The reference case projects that this share will increase to approximately 57 percent in 2020.

- Production of low cost, low-sulfur subbituminous coal from the Powder River Basin is projected to grow at an annual rate of 2.5 percent annually, compared to a national growth rate of 0.9 percent.

Coal Distribution by Sulfur Content: AEO99 - Fig 117

- Phase 2 of the Clean Air Act Amendments, which begins in 2000, tightens annual sulfur dioxide emissions limits on large, higher emitting plants and also set restrictions on smaller, cleaner plants.

- Low sulfur coal is projected to increase gradually in market share from 40 percent in 1997 to 51 percent in 2020. (Low sulfur coal produces less than 1.2 pounds of SO2 per MMBtu).

Coal Minemouth Prices: AEO99 - Fig 108

- Minemouth coal prices are projected to decline by $5.40 per ton in constant 1997 dollars, from $18.14 per ton in 1997 to $12.74 per ton in 2020. This decline reflects a continuation in productivity improvements over the forecast period as well as a continuing shift to the lower priced, low Btu coal of the Powder River Basin.

- Over the forecast period, assumptions regarding productivity growth account for approximately 60 percent of the projected price decline, while regional shifts in production account for the remaining 40 percent.

Labor Productivity by Region: AEO99 - Fig 109

Historical Trend

- Measured in tons per miner hour, U.S. coal mining productivity has risen continuously since 1977, increasing at an average rate of 6.2 percent per year. On average, each U.S. coal miner produced more than three times as much coal per hour in 1997 as in 1977. On the positive side, these gains have allowed coal to remain competitive with other fuels over the period, despite increasing environmental costs at coal-fired power plants.

- On the other hand, employment in the U.S. coal industry has plummeted, declining from 225 thousand miners in 1977 to 81.5 thousand miners in 1997.

Forecast Period

- Over the forecast period, labor productivity improvements are assumed to continue, but to decline in magnitude. This is based on the expectation that further penetration of

productive mining technologies such as longwall units at underground mines and large capacity surface mining equipment at surface mines will gradually level off.

- In the *AEO99* reference case, labor productivity rises at an average rate of 2.3 percent per year over the forecast period. By region, productivity rises at a slightly faster pace West of the Mississippi River, reflecting further concentration of western production in the Powder River Basin (PRB). In 1997, the average productivity for PRB mines was approximately 35 tons per miner hour. This compares with an average of 6.04 tons per miner hour for all U.S. coal mines.

(Note to speaker--the average value shown is correct. It is heavily influenced by the substantially greater number of hours required for eastern coal production.)

Labor Cost Component of Minemouth Prices: AEO99- Fig 110

- The contribution of wages to minemouth coal prices fell from 31 percent in 1970 to 17 percent in 1997, and is projected to decline to 15 percent by 2020.

- Improvements in labor productivity have been, and are expected to remain, the key to lower mining costs.

Average Minemouth Coal Prices in 3 Mining Cost Cases: AEO99 - Fig 111

- Two alternative **Mining Cost Cases** were run to show how minemouth coal prices and regional coal distribution patterns vary with changes in mining costs.

- In the AEO99 reference case projections, productivity increases by 2.3 percent a year through 2020, while wage rates are constant in 1997 dollars. The national minemouth coal price declines by 1.5 percent a year to $12.74 per ton in 2020.

- In the low mining cost case, productivity increases by 3.8 percent a year, and real wages decline by 0.5 percent a year. The average minemouth price falls by 2.4 percent a year to $10.42 per ton in 2020. Eastern coal production is 17 million tons higher in the low case than in the reference case in 2020, reflecting the higher labor intensity of mining in eastern coalfields.

- In the high mining cost case, productivity increases by 1.2 percent a year, and real wages increase by 0.5 percent a year. The average minemouth price of coal falls by 0.8 percent a year to $14.94 per ton in 2020 (17.3 percent higher than in the reference case). Eastern production in 2020 is 52 million tons lower in the high labor cost case than in the reference case.

Carbon Emissions by Fuel: AEO99 - Fig 120

- Petroleum products are the leading source of carbon emissions from energy use. In 2020, petroleum accounts for 42 percent of the total 1,975 million metric tons of carbon emissions in the reference case. About 81 percent of this amount (from petroleum) results from transportation use.

- Coal is the second leading source of carbon emissions, accounting for 34 percent. Most of the increase in coal emissions originates from electricity generation.

- Of the fossil fuels, natural gas consumption and emissions increase most rapidly through 2020, at average annual rates of 1.7 percent.

- The use of renewable fuels and nuclear generation, which emit little or no carbon, mitigates the growth of emissions.

Carbon Emissions from Electricity by Fuel: AEO99 - Fig 121

- Although electricity produces no carbon emissions at the point of use, electricity generation currently accounts for 36 percent of total carbon emissions.

- Retirements of nuclear capacity will result in a 43 percent decline in nuclear generation.

- To compensate for the loss of nuclear capacity and to meet rising demand, generation from fossil fuels will raise electricity related carbon emissions by 213 million metric tons, or 40 percent from 1997 levels

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- Coal, which accounts for about 52 percent of generation in 2020 (excluding cogeneration), produces 81 percent of electricity-related carbon emissions.

- In 2020, natural gas accounts for 30 percent of electricity generation but only 18 percent of electricity-related carbon emissions. Per unit of generation, natural gas produces only half the carbon emissions of coal.

Carbon Emissions in 3 Macro Cases: AEO99 Data

- To reflect the uncertainty in forecasts of economic growth, AEO99 includes high and low economic cases in addition to the reference case. The cases incorporate different growth rates for population, labor force, and labor productivity.

- GDP increases at an annual rate of 2.6 percent in the high growth case, 2.1 percent in the reference case , and 1.5 percent in the low growth case.

- In the reference case, carbon emissions increase at a rate of 1.3 percent annually. Carbon emissions respond to the different rates of economic growth and result in a spread of 300 million metric tons by 2020--approximately 150 above and below the reference case projection of 1975 million metric tons.

U.S Coal Production in 3 Macro Cases

- The strong correlation between economic growth and electricity use accounts for the variation in coal demand across the economic growth cases.

- The difference in coal production between the two economic growth cases in 2020 is 166 million tons, with coal use for generation accounting for 144 million tons.

Carbon Emissions in 3 Tech Cases: AEO99- Fig 32

- The AEO99 reference case includes continued improvements in technology for both energy consumption and production.

- As a result of continued improvements in the efficiency of end-use and electricity generation, total energy intensity in the reference case declines at an average annual rate of 1 percent between 1997 and 2020.

- We ran two sensitivity cases to examine the effects of different assumptions regarding the rate of technological improvement.

- The low tech case assumes that all future equipment choices are from the equipment and vehicles available in 1999. New generating technologies are assumed not to improve over time. Aggregate efficiencies still improve over the forecast period as new equipment is chosen to replace older stock and the capital stock expands.

- The high tech case incorporates a set of technological assumptions developed in consultation with experts in technology engineering, including higher efficiencies, more rapid market penetration, and lower costs.

- In contrast to the 1 percent rate of energy intensity decline in the reference case, there is a decline of 0.8 percent in the low tech case and 1.3 percent in the high tech case.

- The lower energy consumption in the high tech case lowers carbon emissions from 1975 million metric tons to 1848 million metric tons in 2020. In the 1999 technology case, emissions increase to 2105 million metric tons.

- To achieve greater reductions in energy consumption or carbon emissions, it is likely that either market policies (for example higher energy prices) or non-market policies (for example, new standards) may be required.

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Carbon Emissions (7 Cases): Kyoto Report- Figure ES1

- The Kyoto Protocol, which was negotiated in late 1997 to address concerns about climate change, calls for developed nations to reduce greenhouse gas emissions relative to 1990 levels.

- In 1998, at the request of the Committee on Science of the U.S. House of Representatives, the EIA analyzed the Kyoto Protocol, focusing on U.S. energy use and prices and the economy in the 2008-2012 time frame. The NEMS model provided the modeling platform that was used to develop the results.

- The analysis included a reference case (similar to the AEO98 reference case) and 6 cases that represent a range of emission reduction targets that could result under different assumptions regarding emissions trading and the accounting for sinks related to agriculture, forestry, and land use.

- Each case was analyzed to estimate the energy and economic impacts of achieving an assumed level of reductions relative to the 1990 level.

- In each of the carbon reduction cases, the target is achieved on average for each of the years in the first commitment period, 2008 through 2012.

- The reference case carbon emissions level is 1791 in 2010; whereas the (1990 -7 percent) averages 1250 million metric tons in the commitment period, or 96 million metric tons less that 1990 and 542 million metric tons than the reference case.

Carbon Prices (7 Cases) : Kyoto Report - Figure ES2

- There are three ways to reduce energy-related carbon emissions: reduce demand for energy services, adopt more energy-efficient equipment, and switch to less carbon-intensive or noncarbon fuels.

- To reduce emissions, a carbon price is applied to the cost of energy.

- The carbon price is applied to each of the energy fuels relative to its carbon content at the point of consumption.

- The carbon prices projected to be necessary to achieve the carbon reduction targets range from $67 per metric ton ($1996) in the 1990 + 24 percent case to $348 per metric tons in the 1990 minus 7 percent case.

- Delivered coal prices are affected more by carbon prices than other fuel prices. They are between 153 and 800 percent higher.

- The various cases show prices for electricity between 20 and 86 percent higher in all end-use sectors.

Electricity Generation by Fuel (9 Percent Case): Small Kyoto Report - Page 6

- Over one-third of all primary energy consumed by the United States goes into producing and delivering electricity.

- More than one-half of all U.S. electricity generated in 1997 was produced from coal- a fuel that emits more carbon dioxide per unit of electricity generated than any other fuel.

- And, unlike many other end uses, the are a range of fuel options for electricity generation.

- Thus, electricity production and consumption is likely to be a major focus in meeting Kyoto targets --including fuel switching away from more carbon-intensive generation.

- In the 1990 + 9 percent case, for example coal generation drops to 48 percent of the reference case levels and then continues to decline reaching to 25 percent of the 2020 reference case level

U.S. Coal Production (7 Cases): Kyoto Report- Fig 105

- In the carbon reduction cases, U.S. coal production begins a slow decline early in the next decade, accelerates rapidly downward through 2010, and then continues to drop slowly through 2020.

- The projected declines in coal production result primarily from sharp cutbacks in the use of steam coal for electricity generation.

- Coal production levels in 2010 range from a reference case level of 1287 million tons to 624 million tons in the 1990+9 percent case to 313 million tons in the 1990-7 percent case.

- EIA estimates that coal mine employment in 2010 would drop from 68,500 in the reference case (which reflects the effect of continuing gains in productivity and a further shift to western coal) to 42,500 in the 1990+ 9 percent case and 25,500 in the 1990-7 percent case.

Closing Comments

I have presented the mid-term projections views of EIA today and covered a range of topics and issues.

Energy projections are subject to much uncertainty.

Many events that shape energy markets cannot be anticipated such as new legislation, political disruption, and technological breakthroughs.

Many of the key uncertainties have been addressed through alternative cases that were discussed today.

I would be happy to answer any questions that you might have.